REMARKS

In the Office Action dated March 14, 2003, the Examiner rejected claims 19, 22-24 and 26-28 under 35 USC 102(e) as being anticipated by Schueller (US Patent No. 6,507,118), rejected claims 20 and 25 under 35 USC 103(a) as unpatentable over Schueller and Kato (US Patent No. 6,486,562), rejected claim 21 under 35 USC 103(a) as unpatentable over Schueller and Morihara (US Patent No. 5,495,439), rejected claims 29-31 under 35 USC 103(a) as unpatentable over Schueller, and rejected claims 32-34 under 35 USC 103(a) as unpatentable over Schueller and Chiu. In response thereto, the Applicants have amended claims 19, 21, 24, 25, 26, 32 and 33. New claims 35 through 43 have been added. Claims 19 through 43 remain at issue.

Amendments to the Claims

The attorney for the Applicants submit that the amendments to the claims 19-34 were made to better define and clarify these claims. The amendments were not made to distinguish the present invention as claimed over the prior art.

The Art Rejections

The Applicants submit that claim 19 is fully supported by the parent application Serial No. 09/359,214 (now US Patent No. 6,352,881) filed on July 22, 1999. The Schueller reference, which has an effective filing date of July 14, 2000, is therefore not prior art with regard to this claim or new claim 35 and many/all of their dependents.

As illustrated in figure 1, the Schueller reference is directed to the mounting of a flip chip 22 onto an interposer 10 and then mounting the interposer 10 to a substrate 28. The aforementioned structure is made by: (i) aligning the bond pads 24 of the flip chip 22 with contact members 16 on the surface of an interposer 10 (see Column 5, lines 21-26); (ii) applying

an underfill material 27 between the flip chip 22 and the interposer 10 (see Column 5, lines 35-40); and (iii) mounting the combination flip chip 22 and interposer 10 to the substrate 28 (see column 5, lines 46-58). This sequence is also illustrated in Figure 10 where the step 414 labeled "Deposit Underfill Material" takes place after the flip chip is mounted to the interposer (see steps 402 through 412 and Column 8 lines 12-44). As such, even if the Schueller reference were prior art, it would not teach the present invention as claimed which is directed to the application of an underfill adhesive laser on a flip chip or wafer before the flip chip is mounted onto a substrate.

The Schueller reference is thus similar to the prior art described in the background section of the present invention: i.e., filling the gap between a flip chip mounted onto a substrate with an underfill material after the two are mounted together. In contrast, claim 19 is directed to the application of the adhesive layer onto the flip chip before it is mounted onto a substrate. Claim 19 is therefore allowable. Although patentable in their own right, claims 20-34 are patentable based on their dependency on claim 19. Wafer level claims 35-43 are also allowable for essentially the same reasons above.

Applicant believes that all pending claims are allowable and respectfully requests a Notice of Allowance for this application from the Examiner. Should the Examiner believe that a telephone conference would expedite the prosecution of this application, the undersigned can be reached at the telephone number set out below.

Respectfully submitted,
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APPENDIX

All pending claims:

* 19. An apparatus, comprising:

a flip chip integrated circuit having flip chip bond pads with solder bumps formed thereon an active surface of the flip chip; and

a substantially uniform layer of at least partially cured underfill adhesive formed on the active surface of the flip chip integrated circuit that is formed on the flip chip before the flip chip is mounted onto the substrate upon which the flip chip integrated circuit is intended to be mounted.

20. The apparatus of claim 19, wherein the underfill adhesive includes one or more of the following components: an epoxy resin, a hardener, a catalyst initiator, a coloring dye, and an inorganic filler.

* 21. The apparatus of claim 19, wherein the underfill adhesive has a coefficient of thermal expansion substantially similar to that of [a] the substrate upon which the flip chip integrated circuit is intended to be mounted.

22. The apparatus of claim 19, wherein the underfill adhesive is deposited on the active surface of the flip chip integrated circuit at a pre-cured height such that the solder bumps are at least exposed through the underfill adhesive after the partial curing.

23. The apparatus of claim 22, wherein the pre-cured height of the underfill adhesive applied to the wafer ranges from 140% to 90% of the height of the solder bumps.

* 24. The apparatus of claim 19, wherein the underfill adhesive layer is deposited on the active surface of the flip chip integrated circuit in wafer form before the flip chip integrated circuit is singulated from the wafer.

* 25. [A] The apparatus of claim 19, wherein the underfill adhesive is selected from the group comprising: epoxies, poly-imides, silicone-polyimide copolymers.

* 26. The apparatus of claim 19, [further comprising: a] wherein the substrate [having] has a plurality of contact pads, the contact pads configured to contact the solder bumps of the flip chip when the flip chip is mounted onto the substrate, the contact pads and the solder bumps forming joints electrically connecting the flip chip to the substrate.

27. The apparatus of claim 26, wherein the underfill adhesive material is fully cured when the solder bumps of the flip chip and the contact pads of the substrate are reflowed.

28. [A] The apparatus of claim 19, wherein the layer of underfill adhesive is substantially opaque thereby protect[ed]ing the flip chip integrated circuit from photo induced leakage currents by blocking visible light.

29. The apparatus of claim 19, wherein the underfill adhesive has a coefficient of thermal expansion in the range of approximately 20 x 10^{-6}/K to approximately 30 x 10^{-6}/K @ 25 ^{0}C.

30. The apparatus of claim 19, wherein the underfill adhesive melts at between 120 to 140 degrees C and reacts at between 175 to 195 degrees C.

31. The apparatus of claim 19, wherein the underfill adhesive has an elastic modulous in the range of 1 to 10 GPa.

* 32. The apparatus of claim [19] 24, further comprising a dam around the periphery of the wafer to prevent the underfill material deposited onto the [active] surface of the wafer from flowing off the wafer before the partial curing of the adhesive layer.

33. The apparatus of claim 26, wherein a solder paste is provided on the [bond] contact pads of the substrate prior to mounting the flip chip.

34. The apparatus of claim 26, wherein a fluxing material is provided on the substrate prior to mounting the flip chip.

35. An apparatus, comprising:

a semiconductor wafer having an active surface including a plurality of die formed thereon;

one or more bond pads formed on the plurality of die;

one or more solder bumps formed on the one or more bond pads respectively; and

a layer of at least partially cured underfill adhesive formed on the active surface of the wafer.

36. The apparatus of claim 35, wherein the underfill adhesive is deposited on the active surface of the wafer at a pre-cured height such that the solder bumps are at least exposed through the underfill adhesive after the partial curing.

37. The apparatus of claim 36, wherein the pre-cured height of the underfill adhesive applied to the wafer ranges from 140% to 90% of the height of the solder bumps.

38. The apparatus of claim 34, wherein the underfill adhesive is selected from the group comprising: epoxies, poly-imides, silicone-polyimide copolymers.

39. A apparatus claim 34, wherein the layer of underfill adhesive is substantially opaque.

40. The apparatus of claim 34, wherein the underfill adhesive has a coefficient of thermal expansion in the range of approximately 20 x 10^{-6}/K to approximately 30 x 10^{-6}/K @ 25 ^{0}C.

41. The apparatus of claim 34, wherein the underfill adhesive melts at between 120 to 140 degrees C and reacts at between 175 to 195 degrees C.

42. The apparatus of claim 34, wherein the underfill adhesive has an elastic modulous in the range of 1 to 10 GPa.

43. The apparatus of claim 34, further comprising a dam around the periphery of the wafer to prevent the underfill material deposited onto the active surface of the wafer from flowing off the wafer before the partial curing of the adhesive layer.